Space Weather Technical Forecast

Issued on Sunday, 14 April 2024 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance G1/G2 day 1-2 (14/15 Apr) from CME arrivals, and CH fast wind onset. Chance of isolated M-flares.

Solar Activity: Moderate with one M-class flare, peaking M2.4 at 13/0502 UTC from AR3637 in the southeast. There are ten sunspot regions on the disc, seven of which are numbered, however the majority are small and simple. The largest region is AR3634 which has seen ongoing emergence of intermediate spots and consolidation into the main leader and trailer, but remains a simple bipolar configuration. This also produced a C5.5 flare at 13/1459 UTC. A number of small sunspots are visible within plage on both the southeast and northeast limbs, and further regions have the potential to rotate onto the disc.

A CME was produced from the C5.5 flare, however this appears to be slow and relatively narrow, largely passing north and behind Earth, although analysis is ongoing. No other Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR/ACE at L1, showed a slow wind regime. Solar wind speed persisted at background, from 300-400 km/s. Density remained below average. Interplanetary Magnetic Field (IMF), Bt, was weak below 6nT, while the north-south component, Bz, was variable in direction and range between +4/-3nT. Phi angle was positive (away from the Sun). Resultant geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at Background. High energy electron flux (greater than 2MeV) observed at GOES16 was Background to Moderate, with a peak of 460pfu observed at 13/1825UTC. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 1.58e7 integrated pfu recorded at 14/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected, with a chance of further isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are two CMEs with potential Earth-directed components. The first from a filament eruption on 11 Apr, with a glancing impact possible later day 1 (14 Apr). The second is from a filament eruption on 12 Apr, and most likely to give a direct impact but is faint in imagery leading to low confidence with it's the strength, most likely arriving day 2 (15 Apr). Otherwise, onset of CH24/- fast wind is expected to occur day 1 (14 Apr), with wind speeds likely increasing to around 450-500km/s, before easing again day 3-4 as any CME influence also recedes. Geomagnetic activity is expected to increase from initially Quiet to be Active with a chance G1 Minor to G2 Moderate Storm intervals on each of day 1 and day 2 (14-15 Apr) from the combined fast wind or CME arrivals, with a slight chance of G1 Minor Storms on day 3 (16 Apr). Activity easing to be mainly Quiet thereafter.

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES18 is expected to persist at Background. High energy electron flux at GOES16 is expected ease to background with the onset of any fast wind and CME arrivals, before likely rising day 3-4 (Apr 16-17). This will give a slight chance of the associated 24 hr fluence reaching the Active

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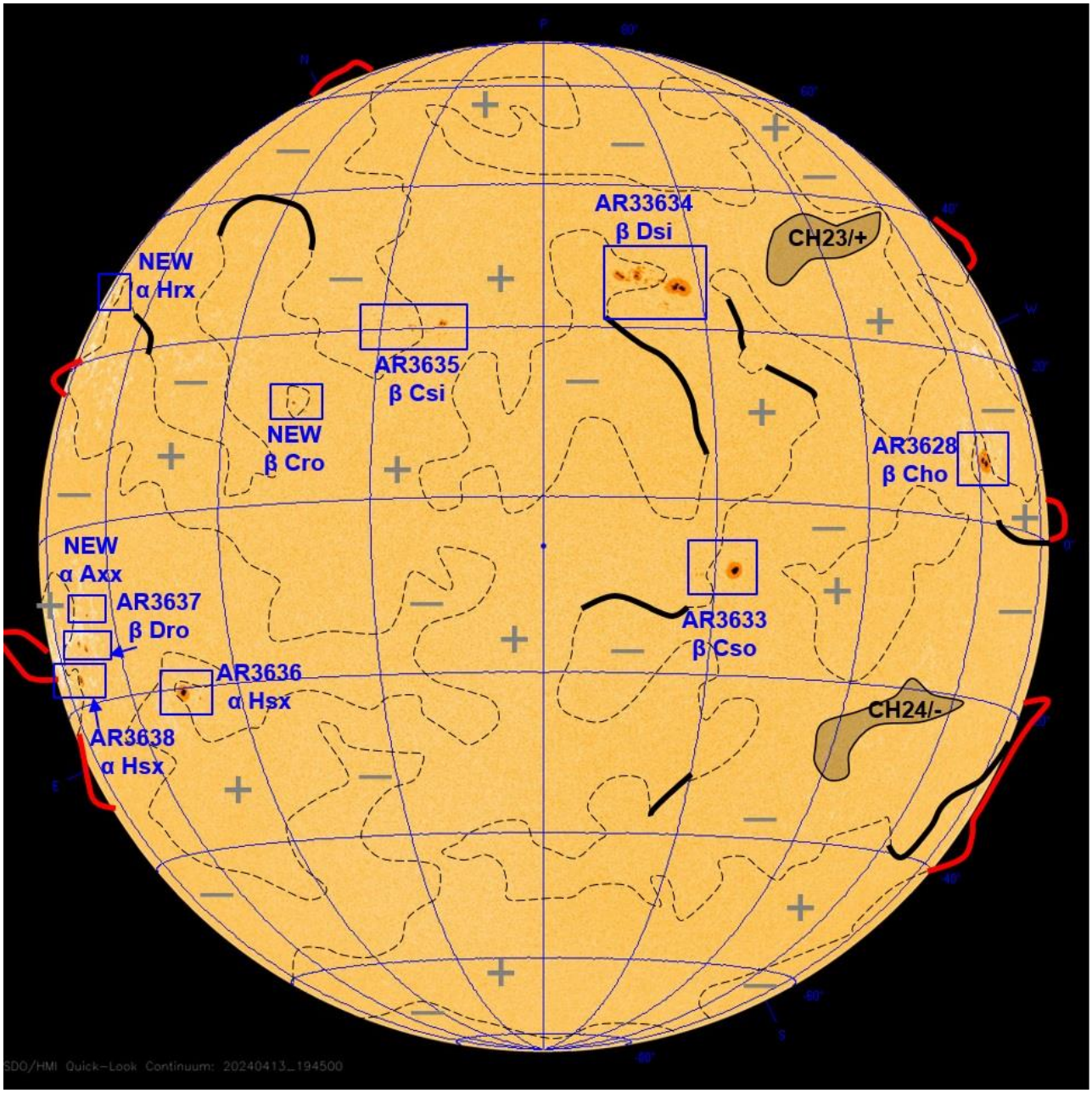
threshold by the end of the period.

Figure 1. Solar Analysis Valid 13/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two CMEs with the potential for Earth-directed components. The first is from the north-centre filament eruption 11/0540UTC, with the potential for a glancing impact late on day 1 or day 2 (14-15 Apr). MOSWOC Enlil suggests a most likely arrival of 14/1900UTC, although this is likely slightly over-estimated due to the model overestimating the extent of a recent fast wind enhancement, with slower solar winds observed.

The second is from a filament eruption observed just southwest of centre-disc around 12/0020UTC. The subsequent CME is very faint, but perceptible on SOHO C2 and STEREO A difference imagery, as a full halo. The arrival forecast is also affected by the same Enlil model winds, however this has been forecast as arriving early day 3 (15 Apr). While confidence is high for this CME to be Earth-directed, it is much lower for the strength of any arrival due to its faint nature

Onset of the fast wind from CH24/- are also expected day 1 (14 Apr), before easing day 3 (16 Apr) onward, alongside any declining CME influence. This is a recurrent feature, with 450km/s observed last rotation, while negative coronal holes are also still favoured for connection at this time of year. However confidence is low due to the lack of notable enhancement observable in Enlil, besides the potential CME glance.

Geomagnetic activity is expected to increase from initially Quiet to be Active with a chance G1 Minor to G2 Moderate Storm intervals on each of day 1 and day 2 (14-15 Apr) from the combined fast wind or CME arrivals, with a slight chance of G1 Minor Storms on day 3 (16 Apr). Activity easing to be mainly Quiet thereafter.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	50	5	1
Strong	G3	No	5	10	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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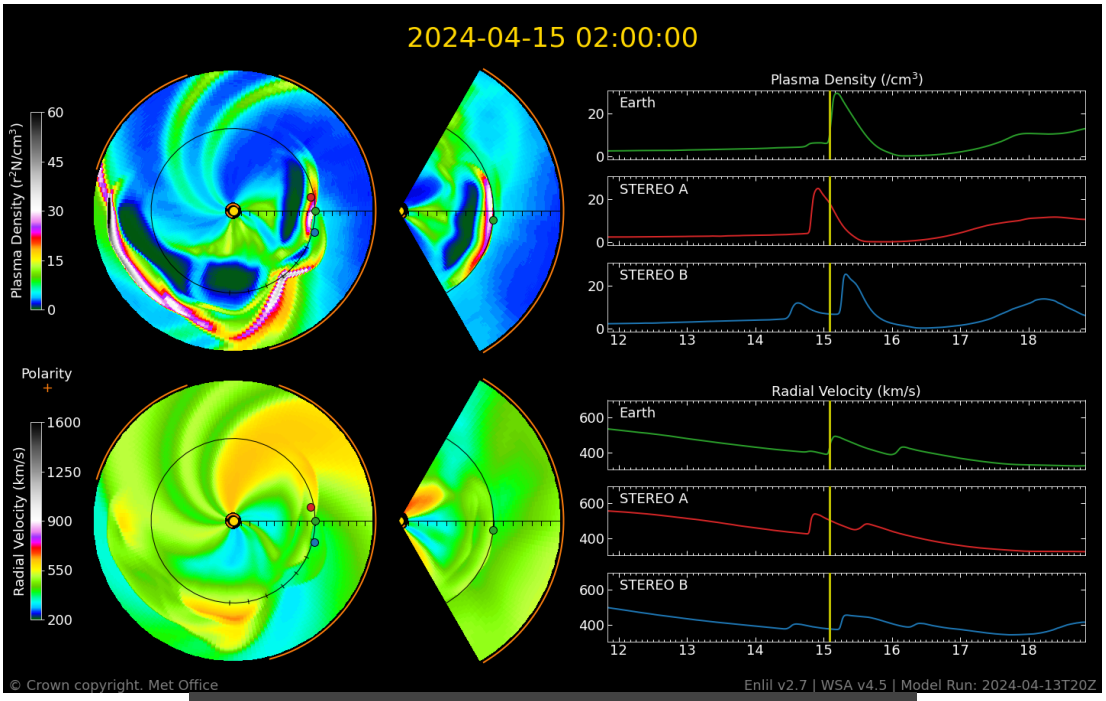
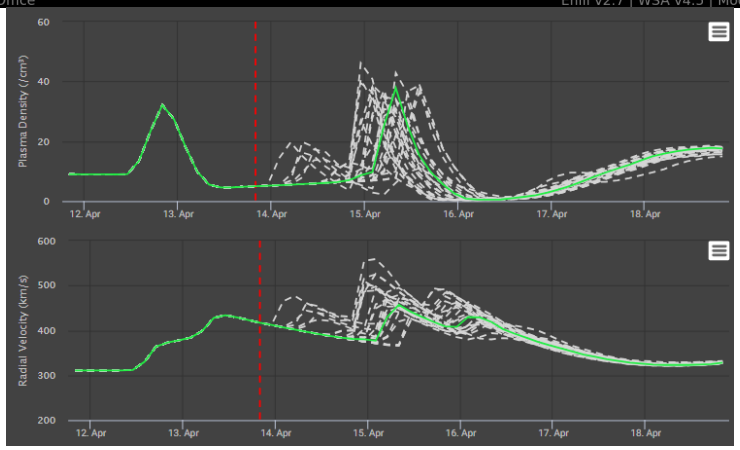
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
12/0620	Full	Filament	SW	670 km/s	15/0300 UTC -4/+8hrs	Direct hit, but weak in imagery so strength low confidence
11/0540	Partial	Filament	N-centre	856 km/s	14/2100 -4/+ 8hrs	Glancing impact despite central disc eruption.

Figure 2: Enlil and ensemble showing potential arrivals





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Radio Blackouts - X-Ray Flares:

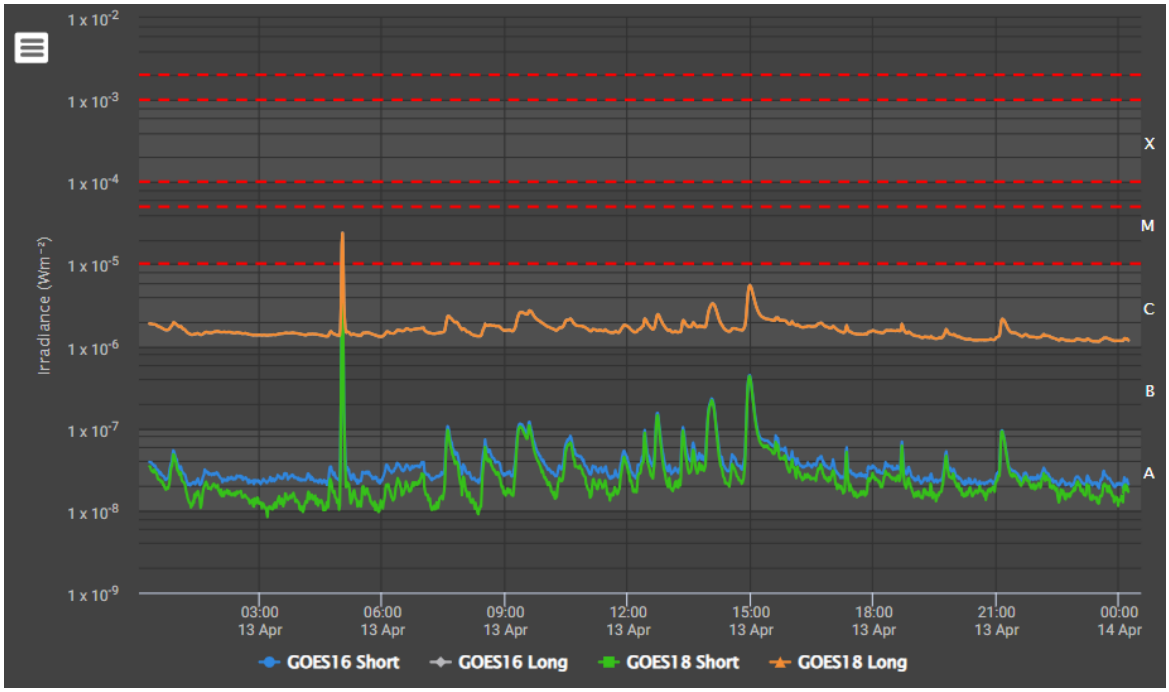
Low to Moderate activity is forecast with an ongoing chance of isolated M-flares each day.

There are ten sunspot regions currently on the Earth-facing disc, however the majority of these are small and simple, and either mature unipolar regions or small bipolar configurations. The main exception is AR3634 which is a moderately sized region in northwest disc which has seen some ongoing growth within its intermediate spots, although this remains magnetically simple.

The majority of recent flaring has been from regions on or over the eastern limb, with significant magnetic looping observed on SDO imagery. Despite this, only small regions have recently rotated onto the disc, set within a large plage area. However, there remains a potential for further regions to rotate onto the disc during the next 24 hours, perhaps most likely in the southeast.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES 16/18 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES18 has remained at Background levels. Solar radiation storms are currently not expected, though a very slight chance of flux increasing is maintained throughout mainly due to the slight development of AR3634 as it moves into the western disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux at GOES16 is expected to temporarily decrease from the current Background to Moderate levels to more persistent Background due to the onset of any fast wind and the potential two CME arrivals. As solar wind pressure eases, flux will likely recover to, perhaps rising to be Moderate to High.

The associated 24 hour fluence is expected to rise in response to any recovery day 3 and day 4 (16-17 Apr), bringing a slight chance of reaching the Active level by day 4 (17 Apr). REFM is giving good guidance to initial conditions, however this will not be taking account of the impact of any CME or fast wind onset later in the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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